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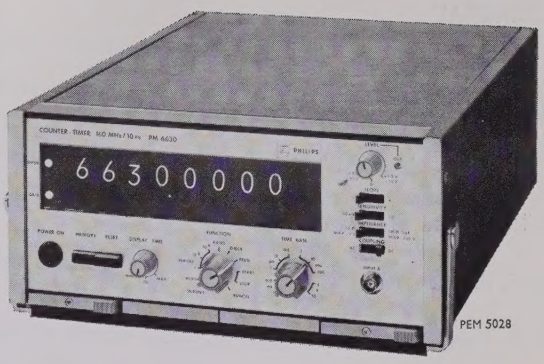

COUNTER-TIMER 160 MHz/10ns

PM 6630 A

9446 066 301.1

PM 6630 B

9446 066 302.1

9499 460 03911 1/8/70/1/04

Operating manual

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IMPORTANT

In correspondence concerning this instrument, please quote the type number and the serial number as given on the type plate at the rear of the instrument.

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General

Introduction

I

The 160 MHz-counter PM 6630 meets the extremely high standards in high frequency applications, such as measurements to communication equipment, measurements of radio/television carrier frequencies, oscillator drift measurements, pulse width and delay measurements, measurements to radar equipment, measuring computer clock frequencies, etc.
Advantage has been taken of the latest techniques by using integrated circuits so that maximum reliability is ensured.
Despite its compact construction special attention has been paid to serviceability.

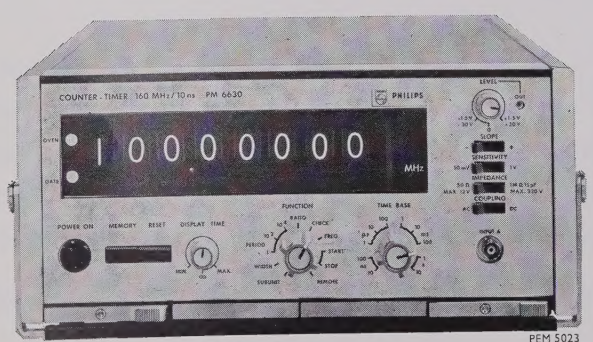
Other features of the PM 6630 are:

— High input sensitivity, 50 mV rms
— Extremely stable triggering
— Switchable input impedance 1 MΩ/ /15pF or 50Ω
— Possibility to measure pulse width and pulse spacing without the use of a sub-unit
— Switchable memory
— BCD-output
— Time base output
— Trigger level output
— Time resolution 10ns
— AC of DC coupling
— Fast warm-up time
— Proportionally controlled oven for quartz X-tal (PM 6630A) or TCXO (PM 6630B)
— Noiseless operation, (no fan)
— Flexible mechanical design

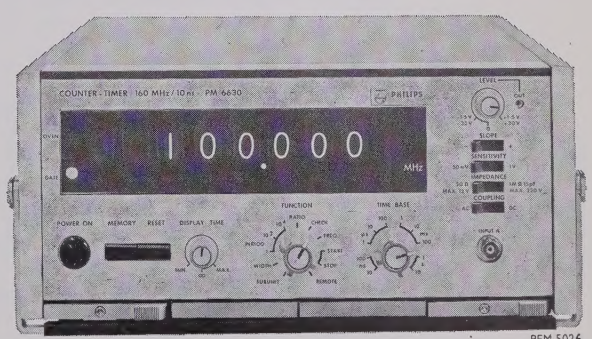
PM 6630 is available in two versions viz:

PM 6630A with 8 digits and ultra stable oven-enclosed X-tal oscillator ($\pm 5 \cdot 10^{-10}/^{0}C$).
Furthermore, remote programming facility and a 4 line BCD output.

PM 6630B with 6 digits and TCXO ($\pm 2 \cdot 10^{-7}/^{0}C$).



PEM 5023



PEM 5026

Cabinets and blank panels

PM 6630A and PM 6630B are supplied without cabinet. The counter can be placed either in a compact cabinet or in a 19″ cabinet.

PM 9714A

Compact cabinet 4/6 rack size including handle, feet, tilting bracket and skin plate covers.

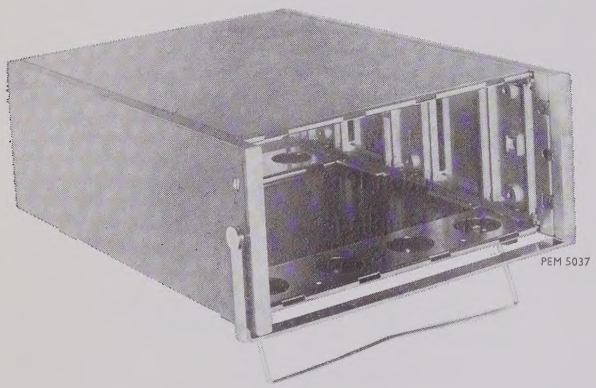


Fig. II-1. Compact cabinet, 4/6 rack size

PM 9716A

19″ cabinet including grips, feet, tilting bracket, skin plate covers and cable cover with 2 angular brackets for 19″ rackmounting.

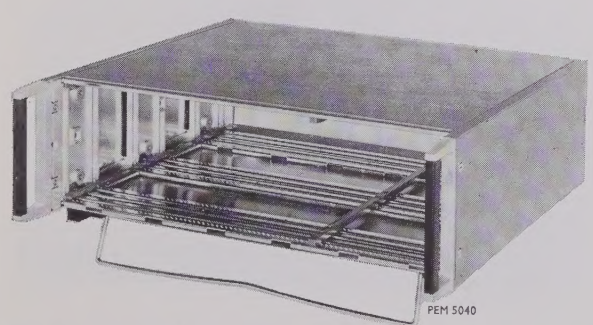


Fig. II-2. 19″ Cabinet (6/6)

PM 9722

Blank panel to fill 2/6 empty space when PM 6630 is accommodated in PM 9716A cabinet and no sub-unit is used.

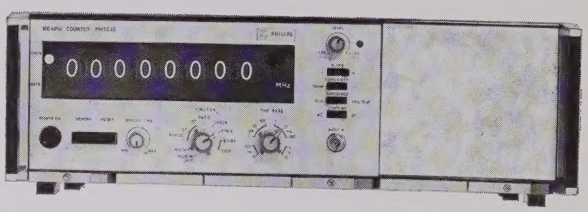


Fig. II-3. PM 6330 accomodated in the cabinet PM 9716A with blank panel PM 9722

PM 9721

Blank panel to fill 1/6 empty space.

Technical data

Properties, expressed in numerical values with statement of tolerances are guaranteed. Numerical values without tolerances are intended for information purposes only and indicate the properties of an average instrument. The numerical values hold good for the nominal mains voltage unless otherwise stated.

MEASUREMENTS

Frequency

Range	0-160 MHz at 50 mV rms
Gate time	1 μs - 10s in decade steps

Period (Single and multiple)

Range	0-10 MHz over 1,10^2 or 10^4 periods
Time resolution	10 ns - 1 s at single period 10 ns - 100 ms at period x 10^2 10 ns - 1 ms at period x 10^4

Pulse width

Range	50ns - 10^6s
Time resolution	10 ns - 1 s depending on TIME BASE switch position

Totalizing

Range	FUNCTION switch in position START accumulates pulses during manually chosen gate time

Frequency ratio

Display	N x F1/F2 N = 1,10,...10^6
F1	0 - 160 MHz (INPUT A)
F2	1 kHz - 10 MHz (EXT. STAND. IN input at the rear)

Scaling

Range	1 kHz - 10 MHz (FUNCTION switch in position START)
Scaling factor	1,10...10^7
Input	BNC-connector (rear)
Output	BNC-connector (rear)

Check

100 MHz counted during time selected by TIME BASE switch

INPUT SPECIFICATIONS

Input A

Connector	BNC
Impedance	1 MΩ/ /15 pF or 50 Ω
Sensitivity	50 mV rms or 150 mV pp for pulses >3ns (Period measurement > 5ns)

Attenuation	1 or 20 times
Coupling	AC or DC
DC blocking voltage	250 V
Trigger slope	+ or —
Trigger level	Variable from —1.5 V to + 1.5 V (attenuation factor = 1) Variable from —30 V to + 30 V (attenuation factor = 20) Locked position for automatic "zero cross" triggering
Overload	± 3 V (sensitivity: 50 mV) ± 60 V (sensitivity: 1 V)
Permissible overload	12 V rms (50 Ω position) or 220 V rms (1 MΩ position)

Time base external input

Connector	BNC
Impedance	1 kΩ/ /50 pF
Sensitivity	1 V rms
Coupling	AC
Permissible overload	10 V rms

Remote input

All functions which are performed by the FUNCTION and TIME BASE switches can be programmed from a remote location.
Connector: Amphenol Micro Ribbon 57 series 50 pin type 57-40500
Matching cable connector: type 57-30500

OUTPUT SPECIFICATIONS

Trigger level output

Trigger voltage (divided by attenuation factor) available for oscilloscope or voltmeter display

Connector	Miniature jack (at front panel)
Source impedance	5 kΩ

Scope outputs (START OUT and STOP OUT)

Connector	BNC
Source impedance	Approx. 50 Ω, AC coupled
Amplitude	400 mV pp into 50 Ω
Pulse width	15 - 60ns
Polarity	Negative going pulses
Delay	Approx. 10ns with respect to start and stop signals

Time base output

Connector	BNC
Source impedance	Approx. 200 Ω, AC coupled
Amplitude	0.5 Vpp into 50 Ω

10 MHz output (x-tal oscillator)

Connector	BNC
Source impedance	Approx. 100 Ω, DC coupled
Amplitude	1 V rms into 1 kΩ

BCD output

4-line BCD 1-2-4-8
Logic level: "0" ⩽ 1 V
"1" > 7.5 V
Connector: Amphenol Micro Ribbon 57 series 50 pin type 57-40500
Matching cable connector: type 57-30500

GENERAL

Display

Indicators

8 numerical indicators PM 6630A
6 numerical indicators PM 6630B
Decimal point
Measurement unit
Gate lamp
Measurement impossible indication "No go"

Oven lamp

Lamp on (when mains flex is connected to mains) indicates that 10 MHz output is available (Version PM 6630A only)

Memory

On/off switch

Display time

Continuously adjustable
Ranges: 2 - 50 ms
0.2 - 5 s
Display can be held infinitely

Reset

Pushing RESET button resets counter and starts new measurement

Oscillator	PM 6630A	PM 6630B
Frequency	10 MHz	10 MHz
Stability: (After 72 hours initial stabilization)	$\pm 3 \cdot 10^{-9}$/24 hours	$\pm 1 \cdot 10^{-7}$/month
Temperature change	$\pm 3 \cdot 10^{-8}$/(0 to + 45°C)	$\pm 5 \cdot 10^{-6}$/(0 to + 35°C)
Average temperature drift	$\pm 5 \cdot 10^{-10}$/°C	$\pm 2 \cdot 10^{-7}$/°C
Warm up time	Less than 7 min. to within $\pm 10^{-7}$	no oven

Mains supply

Mains voltage

100-130 V, 200-260 V, 50-400 Hz

Power consumption

PM 6630A: 50 W (26 W stand by)
PM 6630B: 45 W

Operating temperature

0°C up to + 45°C

Dimensions	Width	Height	Depth
PM 9714A Compact cabinet	305	132	404
PM 9716A 19" cabinet (complete for rack installation)	445	132	445 incl. handles

Weight

Counter + PM 9714A: 9kg
Counter + PM 9716A: 12 kg

Accessories

IV

Standard accessories
(included in the delivery)

1 Cable
1 Mains flex
1 Manual

Optional accessories
(to be ordered separately)

PM 6631 Time interval unit

This sub-unit comprises a second input channel, identical to the one in the basic counter and is used as stop channel for time interval measurements.

PM 6632 Pre-scaler

Extends the counting capability of the PM 6630 to 800 MHz with direct frequency read out.

PM 6632 Pre-amplifier.

Increases the sensitivity of the PM 6630 down to 1 mV rms.

NOTE: The sub-units should be connected to the counter either by means of interconnection cable PM 9663 or rear panel PM 9664. Cable PM 9663 enables interconnection of only one sub-unit whereas with rear panel PM 9664 two sub-units can be interconnected.
Both PM 9663 and PM 9664 should be ordered separately.

PM 9663 Interconnection cable

PM 9664 Rear panel for interconnection of sub-units and the counter.

The plugged in sub-units are connected directly with the counter when the 19" cabinet PM 9716A is provided with this panel.

PM 9714A	Compact cabinet $^4/_6$ rack size	see chapter II
PM 9716A	19" Cabinet	
PM 9721	Blank panel $^1/_6$ rack size	
PM 9722	Blank panel $^2/_6$ rack size	

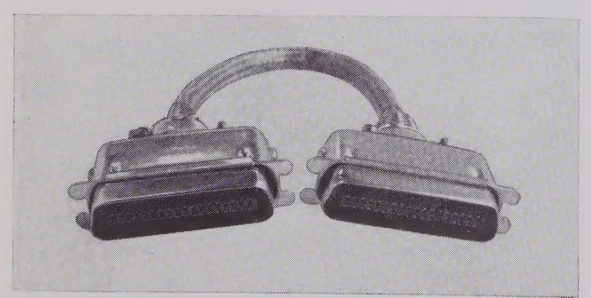


Fig. IV-1. Interconnection cable PM 9663

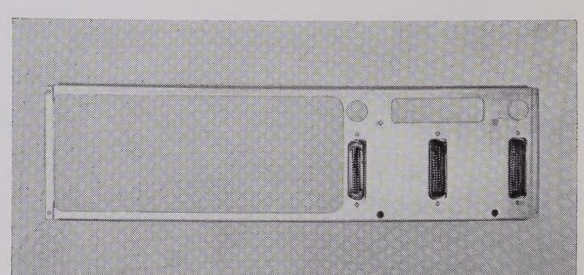


Fig. IV-2. Rear panel PM 9664 for interconnection of the sub-units

Description of the block diagram

The following description of the block diagram is kept brief because in the Service Manual an extensive description will be given. Moreover, chapter "operation" includes simple block diagrams with function descriptions.
The main functional basic sections of the counter are:

— Trigger circuit
— Main gate and control circuits
— Decade counting assemblies
— Oscillator
— Time base dividers

TRIGGER CIRCUIT

In the trigger circuit the input signals are converted into rectangular pulses. The input signal is applied to the trigger circuit via switch COUPLING (S 101). In position AC possible d.c. components are blocked. With switch IMPEDANCE (S 102) the input impedance can be changed over from 50 Ω to 1 MΩ/ /15pF or vice versa. The following attenuator provides an attenuation of 20 x when switch SENSITIVITY (S 103) is set to position 1V. Subsequently, the input signal passes an amplitude limiter and a differential amplifier.
With potentiometer LEVEL (RV 101) the trigger level can be adjusted for counting positive or negative pulses. For checking the trigger conditions an output voltage is available on socket LEVEL OUT (P11).
The Schmitt-trigger is triggered on the positive or negative going edge of the output signal of the differential amplifier, dependent on the position of switch SLOPE (S104).

MAIN GATE AND CONTROL CIRCUITS

The signals to be counted which are applied to the main gate, can be passed on to the decade counting assembly during the time interval that the main gate is open.
In the frequency-measurement mode the main gate is controlld by the time-base pulses via the gate flip-flop. When the main gate is open, the Schmitt-trigger pulses derived from the input signal are counted.
In the period and pulse-width measurement modes, the main gate is governed by pulses coming from the Schmitt-trigger. During the time interval that the main gate is open, the timing units from the time-base are counted.
The control-gating circuit selects the control signals for the gate flip-flop, whereas the counter-gating circuit selects the signals to be counted i.e. the Schmitt-trigger pulses or the timing units.
Both gating circuits are programmed by means of the FUNCTION switch.
In the period-average measurement mode the average value of a repetive input-signal is measured over 10^2 or 10^4 periods.
For this purpose the Schmitt-trigger output pulses are routed via the time-base gating circuit tot a part of the time-base circuit for subdivision by 10^2 or 10^4.
The time-base gating circuit selects the subdivision factor according to the FUNCTION switch setting.

DECADE COUNTING ASSEMBLY

The decade counting assembly consists of 8 high speed decade counters followed by 8 memories (for PM 6630B: 6 high speed decade counters and 6 memories). When switch MEMORY (S2) is **not** depressed, the memories and the display will follow the changes of the decade counters continually.
When switch MEMORY (S2) is depressed the memories cannot follow the changes of the decade counter during the measurement so that the display will not change. However, when the measurement is completed the gate flip-flop switches over and the display flip-flop supplies a read out pulse which opens the memories. The result is that the information from the decade counters is stored in the memories and the reading will change.
The display is retained from 2-50 ms or 0.2 to 5 seconds as dictated by the setting of the DISPLAY TIME control (RV1).
Some time after the appearance of the read out pulse, the display flip-flop produces a pulse to reset itself to its initial state. At the same time the flip-flop supplies a zero-reset pulse to the decade counters, so that they are cleared for the next counting.
Manual resetting can be effected by means of switch RESET (S3).
The PM 6630A has a BCD output. The information for this output is taken from the memories and is applied to the output socket via BCD buffer stages.
The information from the memories is applied to the driver circuits (binary to decimal converters) which convert the binary 4 line code to the 10 line decimal code. The numerical display tubes are driven by the output signals of the drivers.

OSCILLATOR

The 10 MHz oscillator is crystal controlled. In the PM 6630A the crystal is accommodated in an oven whose temperature is electronically controlled.
The 10 MHz oscillator frequency is multiplied to 100 MHz with the aid of frequency multiplier "B". In that case switch S21 is in position INT. and the 10 MHz oscillator signal can pass AND-gate G17 while AND-gate G16 is blocked. Socket EXT. STAND. IN (P27) serves for connection of an external 1 MHz or 10 MHz oscillator. When using a 1 MHz standard oscillator, the 100MHz signal is obtained by multiplication of the 1 MHz signal in the frequency multipliers "A" and "B". In this case S21 is set to position 1 MHz so that the 1 MHz signal passes multiplier "A" and via AND-gate G16 multiplier "B". With S21 in position 1MHz, AND-gate G17 is blocked.

TIME BASE

For frequency and time interval measurements clock pulses are required with an accurately known repetition time of 100 ns to 10 s. For this, the 10 MHz signal is applied to a chain of 10-dividers (D.C.U.'s) so that the desired clock pulses can be selected with the aid of switch TIME BASE (S5). For frequency measurements these pulses are used as control signal for the main gate, while for period maesurements these pulses are employed as timing units which are applied to the input of the main gate. The selected time base signal is available on socket TIME BASE OUT (P26).
In position PERIOD 10^2 and PERIOD 10^4 of switch FUNCTION (S4) the last two and the last four dividers are used respectively to divide the signal to be measured. Consequently in position PERIOD 10^2 timing units 1s and 10s cannot be used and in position PERIOD 10^4 timing units 10 ms up to 10s cannot be used.

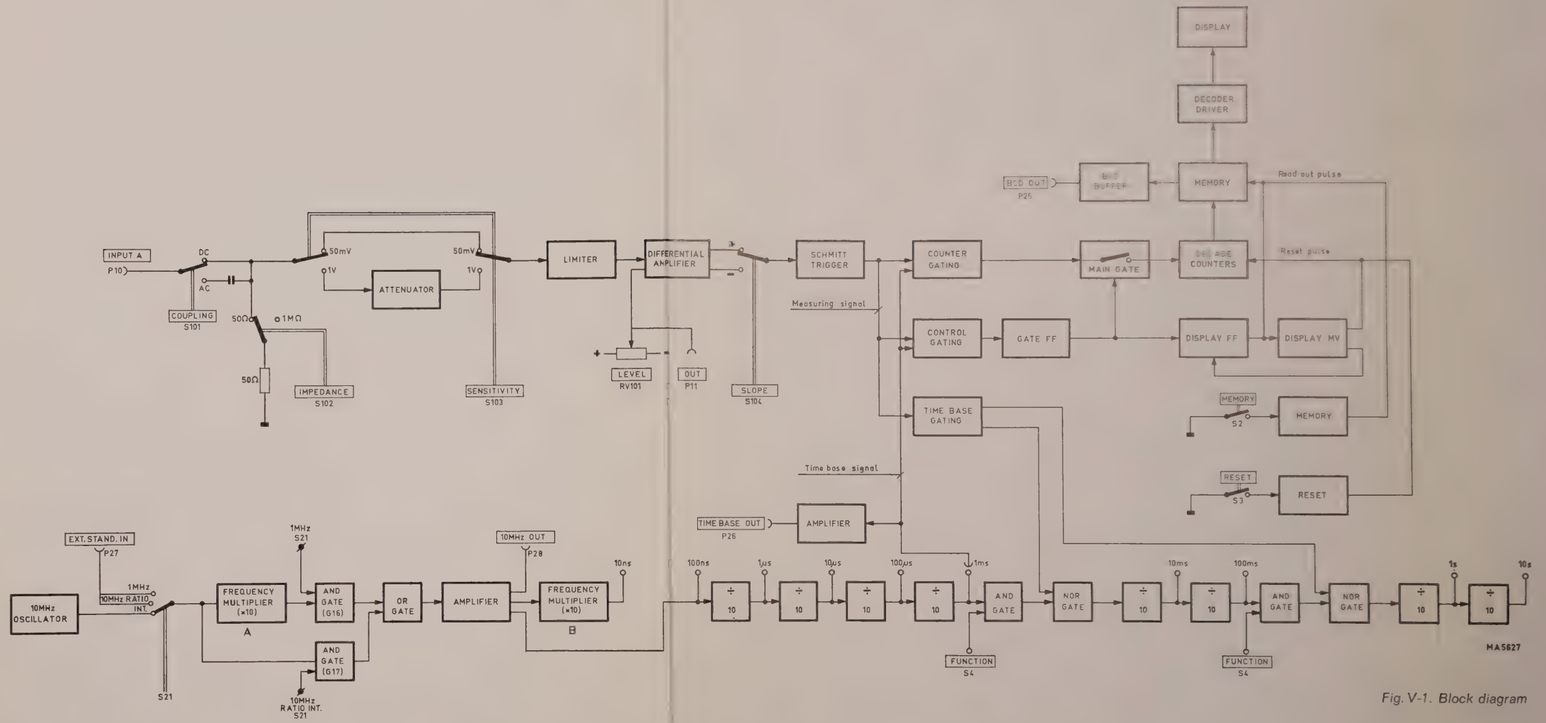


Fig. V-1. Block diagram

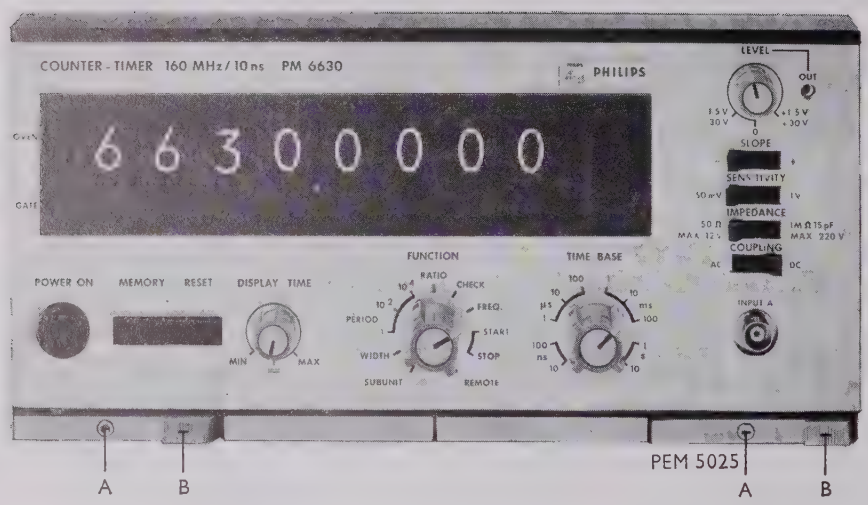


Fig. VI-1. Indication of the locking devices

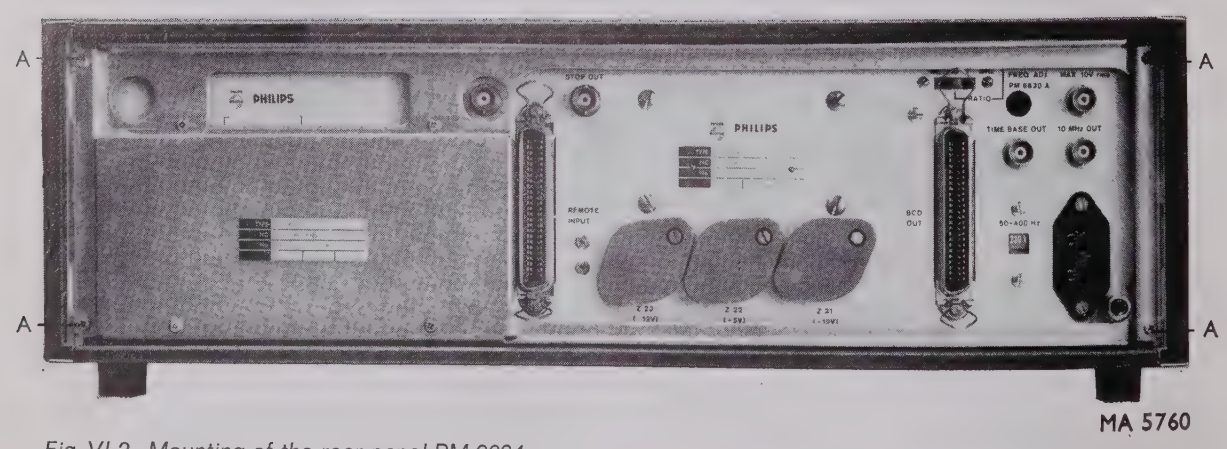


Fig. VI-2. Mounting of the rear panel PM 9664

Directions for use

Installation

VI

A. ASSEMBLING

PM 6630 can be accommodated either in a compact cabinet (4/6 rack size) or a 19″ cabinet.
For accommodation in a compact cabinet proceed as follows (Fig. VI-1):

— Loosen the Allen screws "A".
— Press the knurled part of the locking devices (indicated with B) so that the locking devices hinge out.
— Slide the instrument into the housing, and lock it by pressing back the locking devices.
These can be secured by tightening Allen screws "A".

To accommodate the PM 6630 in a 19″ cabinet the dark grey plastic guide rails should be mounted in the cabinet.
For this case the appropriate holes in the crossbars are threaded. The guide rails must be mounted in such a manner that the cabinet is suitable for a 4/6 unit. Further the PM 6630 can be slid into the housing as described above.

B. RACK INSTALLATION

All 6/6 cabinets are supplied with a light-grey plastic cover. This cover contains two angular brackets for 19″ rack mounting.
These brackets can be mounted on either side of the cabinet

— Remove four screws "1" (Fig. VI-3)
— Slightly lift the side plates at the front and remove the plastic plates "2" which are now accessible; the angular brackets can be fitted in the place of the plastic plates
— Refit the side plates and secure them with screws "1"
— Remove the feet "3"
— Remove the tilting bracket and the two pivot brackets.

C. MOUNTING REAR PANEL PM 9664

— Remove the light grey plastic cover at the rear of the 19″ cabinet
— Fit the rear panel and secure it with screws "A" (Fig. VI-2)
— Slide the counter into the housing, and lock it by pressing back the locking devices.

D. CONNECTION TO THE MAINS

The instrument can be adapted to mains voltages of 100...130 V or 200...260 V by means of S22 (Fig. VII-3) at the rear of the instrument.
Mains voltage between 100...130 V : 115 V setting.
Mains voltage between 200...260 V : 230 V setting.
On delivery the instrument is adapted for a mains voltage between 200...260 V.

E. EARTHING

The instrument should be earthed according to the local safety regulations. This may be effected as follows:

— Via a 3-core mains cable with rim earthing.
— Via earthing terminal P30 at the rear of the instrument.

DOUBLE EARTHING SHOULD BE AVOIDED IN ORDER TO PREVENT HUM.

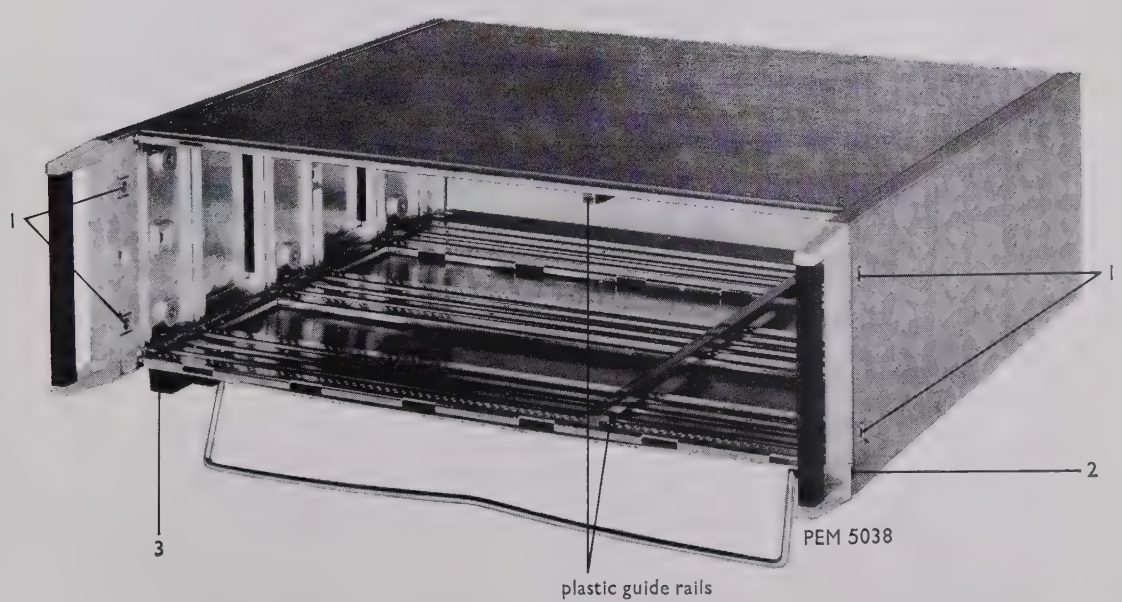


Fig. VI-3. Mounting of the brackets for rack installation

Controls, input and output sockets

VII

Control or socket	Designation	Purpose
S1	POWER ON	Mains switch.
S2	MEMORY	The memory function can be switched on or off. In position off (S2 released) the indicator tubes follow the decade counters continually.
S3	RESET	If RESET is pushed, the decade counters are reset to zero and the display will be zero.
S4	FUNCTION	Operation mode selector. The following modes can be chosen: SUBUNIT when any subunit is used WIDTH for pulse width measurement PERIOD for period time measurement RATIO for comparing two external frequencies CHECK for checking the counter FREQ. for frequency measurements START - STOP for counting and display of the number of incoming pulses during a time determined by the FUNCTION switch. REMOTE for remote control instead of using FUNCTION and TIME BASE switches.
S5	TIME BASE	Selector for gate time in frequency measurements; time resolution selector in width, period and time measurements; selector for division factor in ratio measurements and scaling.
S101	COUPLING	Selector for AC or DC input.
S102	IMPEDANCE	Input impedance selector to select 50 Ω or 1 MΩ/ /15pF input impedance.
S103	SENSITIVITY	Selector for two input sensitivities 50 mV or 1 V.
S104	SLOPE	Enables triggering either on the positive going edge or on the negative going edge of the input pulse.
S21	INT. 10 MHz RATIO 1 MHz	Permits use of the internal time base standard (X-tal oscillator) when set to position INT. In the other positions use can be made of an external time base standard of either 10 MHz or 1 MHz, or the time base standard used in ratio measurements.
S22	(115 V 230 V)	Voltage adapter.
RV1	DISPLAY TIME	Setting of the display time, which is continuously adjustable from 2-50 ms in position FAST and from 0.2-5s in position NORMAL of the display-time switch S401.
RV101	LEVEL	Adjustment of the trigger level. Control in anti clockwise position for 0 V level.
P10	INPUT A	Measuring signal input. Input impedance: 1 MΩ/ /15 pF or 50 Ω.
P11	LEVEL OUT	Trigger voltage output, available for oscilloscope or voltmeter display.
P21	START OUT	Pulse output for monitoring stop trigger point on oscilloscope.
P22	SUBUNIT	Connector for interconnecting a subunit.
P23	STOP OUT	Pulse output for monitoring start trigger point on oscilloscope.

Control or socket	Designation	Purpose
P24	REMOTE INPUT	For connection of a remote control cable.
P25	BCD OUT	BCD output, 4-line code 1, 2, 4, 8.
P26	TIME BASE OUT	Output for internal or external time base standard after frequency division in accordance with setting of TIME BASE switch.
P27	EXT. STAND. IN MAX 10Vrms	Input socket for an external time base standard of 1 MHz or 10 MHz, or for ratio measurements and scaling.
P28	10MHz OUT	Output socket for internal of external time base standard.
P29		Mains input.
P30	⏚	Earthing terminal.
GL1	OVEN	Lighting up indicates that the oven is switched on (only present in PM 6630A).
GL2	GATE	When the lamp lights up the main gate is open.

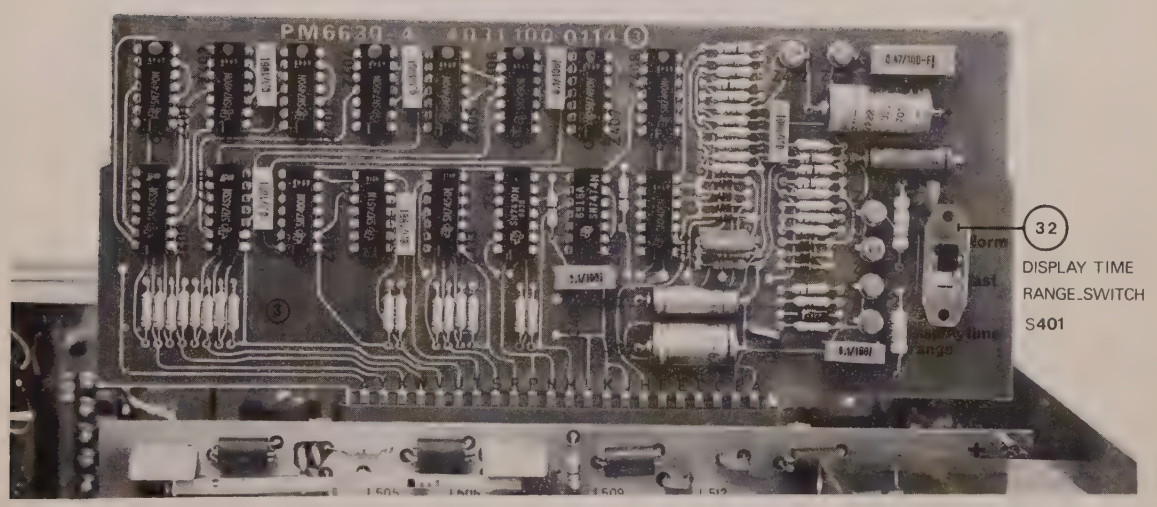


Fig. VII-1. Indication of display-time range switch S401

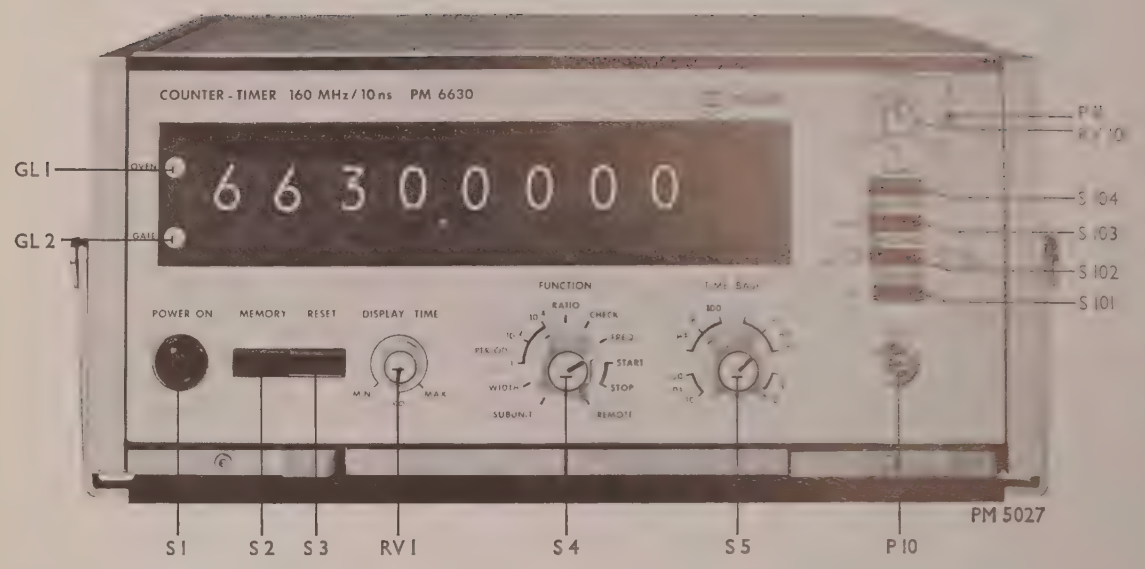


Fig. VII-2. Front view

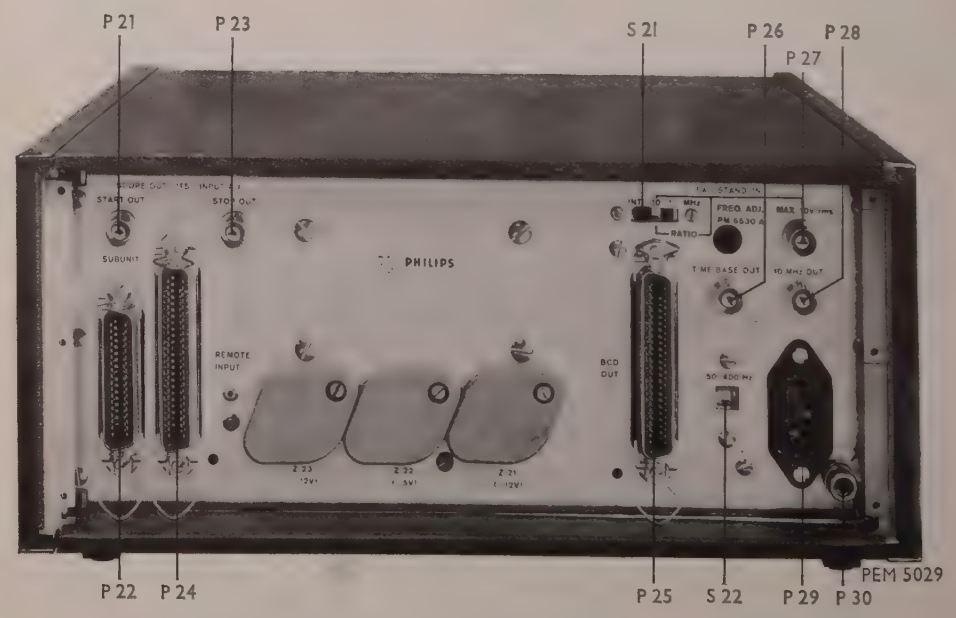


Fig. VII-3. Rear view

Operation

VIII

A. GENERAL

In the PM 6630A a part of the power supply is connected to the mains even if the instrument is switched off. This part delivers a.o. the required supply voltages for the oscillator and control amplifier.

This ensures that the X-tal is at the correct operating temperature because the oven is on.

Before carrying out measurements check that switch EXT. STAND. IN is set to position INT. unless otherwise stated.

B. MEASUREMENTS

CHECK

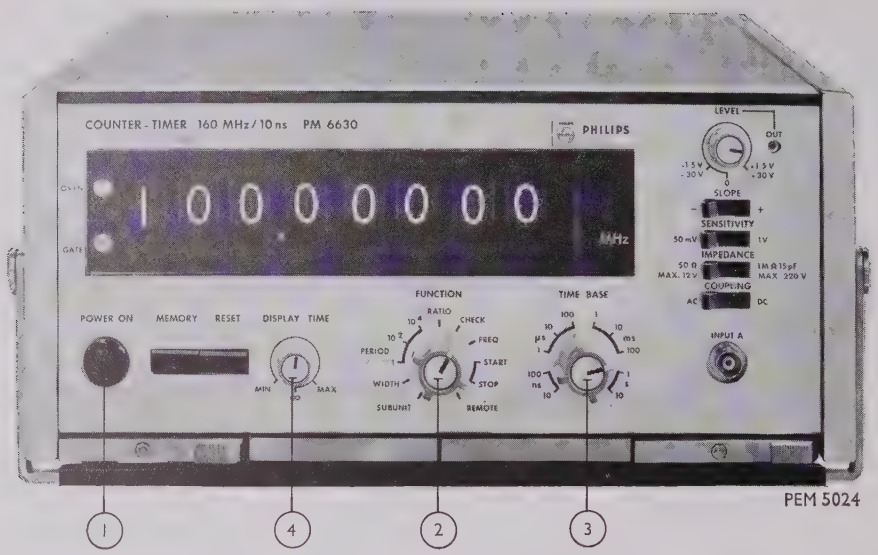


Fig. VIII-1

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to CHECK.
3. Set switch TIME BASE to a position from 1 μs up to 10s.
4. Set DISPLAY TIME potentiometer and display-time switch S401 to a suitable value.

   The correct display ($\pm$ 1 count) for each position of switch TIME BASE is shown in the adjacent table.

TIME BASE setting	DISPLAY
1 μs	100 MHz
10 μs	100.0 MHz
100 μs	100.00 MHz
1 ms	100.000 MHz
10 ms	100.0000 MHz
100 ms	100.00000 MHz
1 s	00000.000 KHz
10 s	0000.0000 KHz

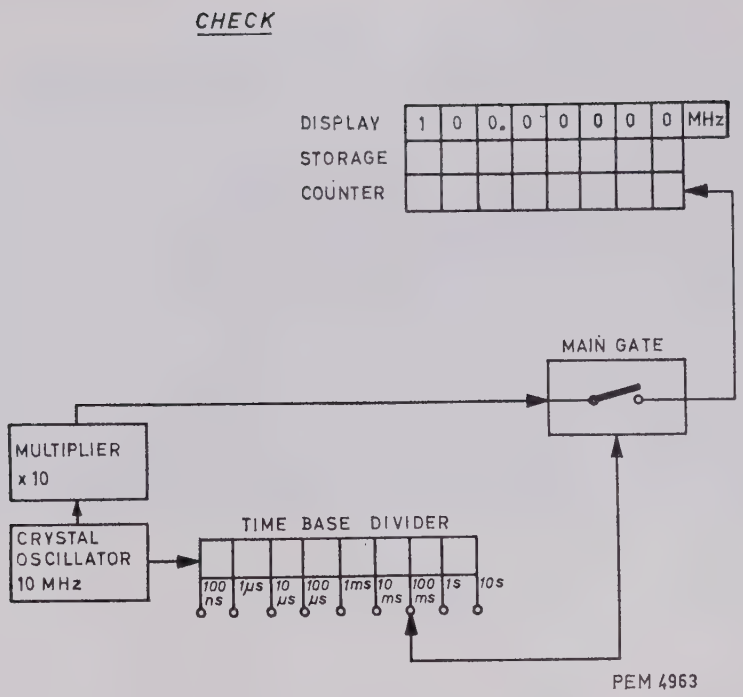


Fig. VIII-2. Simplified block diagram of self check

CHECK

Time base	DP6	DP5	DP4	DP3	DP2	DP1	DP0	Measurement unit
10 ns								No go
100 ns								No go
1 µs							•	MHz
10 µs						•		MHz
100 µs					•			MHz
1 ms				•				MHz
10 ms			•					MHz
100 ms		•						MHz
1 s				•				kHz
10 s			•					kHz

Decimal-point setting and measurement-unit indication as a function of the TIME BASE switch position.

In this mode the 100 MHz frequency (the internal X-tal oscillator frequency multiplied by 10) is counted during a time set by the TIME BASE switch. The result must be always 100 MHz (± 1 count due small phase differences).

TOTALIZING

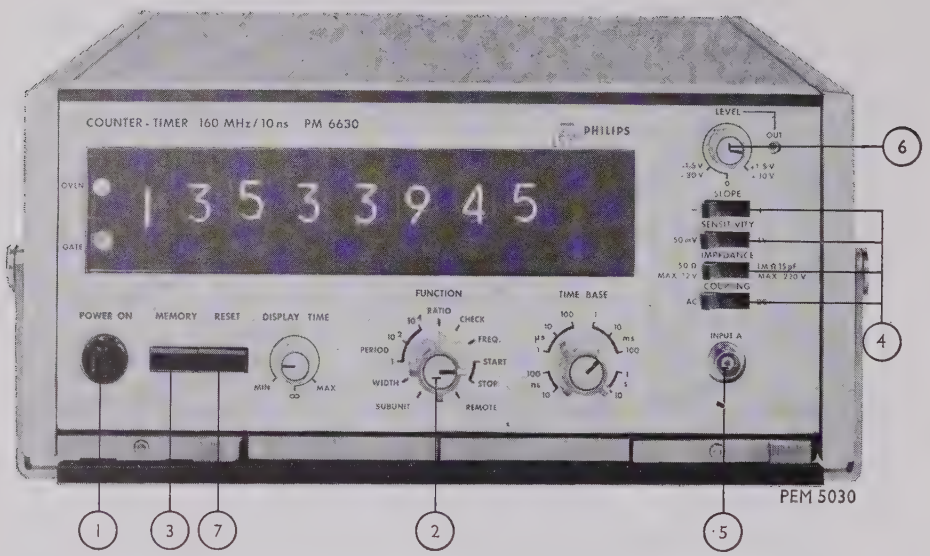


Fig. VIII-3

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to START.
3. Set switch MEMORY to off (released position).
4. Set controls SLOPE, SENSITIVITY, IMPEDANCE and COUPLING to the appropriate positions in accordance with the input signal.
5. Apply the signal to be measured to INPUT A.
6. Adjust the trigger level with LEVEL potentiometer until a stable reading is obtained.
7. Reset the display by pushing the RESET button.

The counter is now ready to accumulate pulses during a time which can be manually controlled by switch FUNCTION (START-STOP).

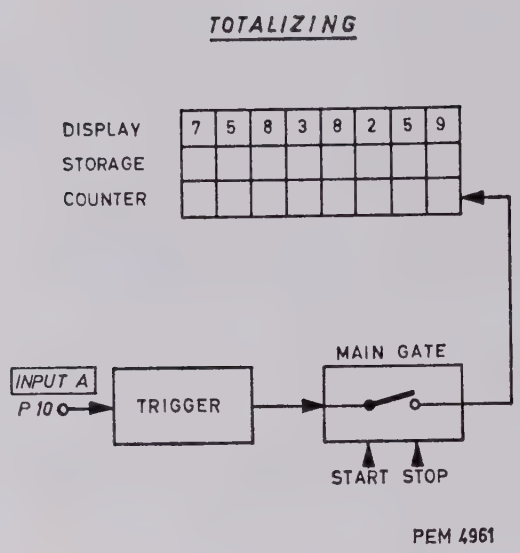
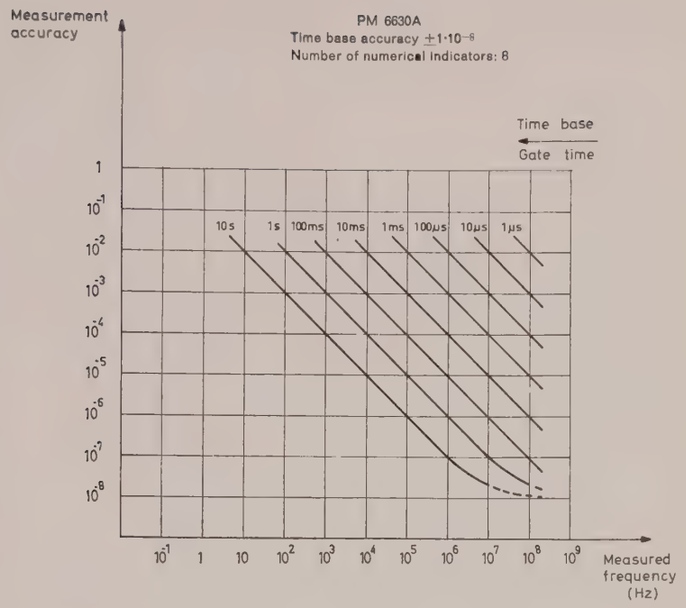
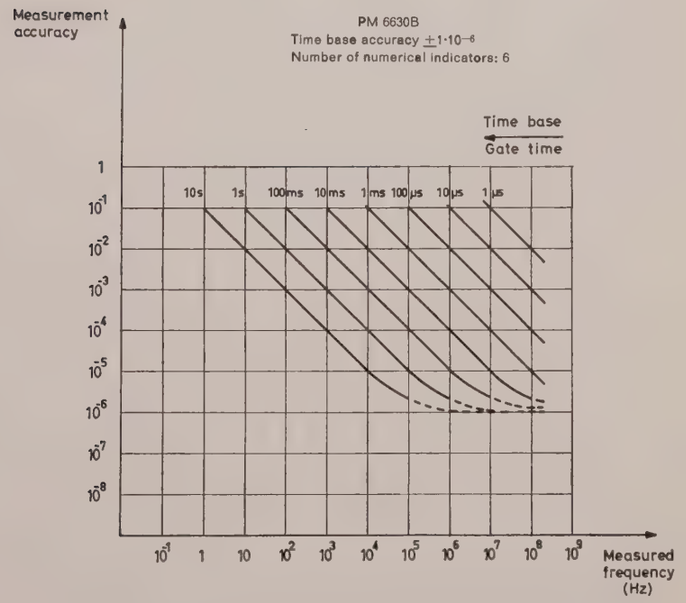


Fig. VIII-4. Simplified block diagram of totalizing operation

In the case of totalizing the number of incoming pulses are counted during a time which can be manually determined by the FUNCTION switch.
The input signal is shaped into a standard waveform by the trigger circuit and, via the main gate circuit, fed to the counting decades. The gate is opened or closed by setting the FUNCTION switch to the START or STOP positions. The first counting decade, governing the digit at right end of the display, is the high frequency decade and can count to 175 MHz.





Dashed lines indicate that display capacity is exceeded.

Fig. VIII-5. Frequency measurement accuracy for PM 6630A and PM 6630B

FREQUENCY

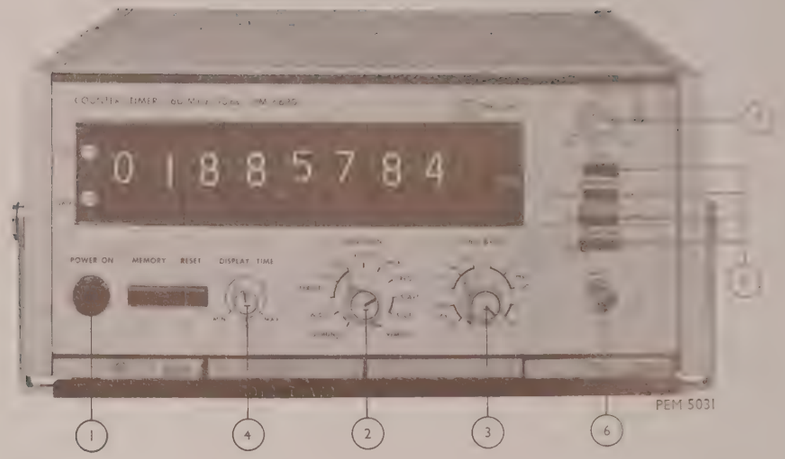


Fig. VIII-6

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to FREQ.
3. Set switch TIME BASE to a suitable value to give a sufficient number of digits.
   Time base means **gate time** in frequency measurements and the number of significant digits displayed depends on the TIME BASE setting i.e.
   frequency x time base = displayed figure.

Example

A frequency of 473.171 kHz and a time base setting of 100 ms will give 473.171 x 100 = 47317 or 5 significant digits. At a time base setting of 1s, 6 digits (473171) are displayed.
In frequency measurements the normal settings are 10 ms...10 s.

4. Set DISPLAY TIME potentiometer and display-time switch S401 to a suitable value.
5. Select the proper input conditions in accordance with the input signal by means of switches SLOPE, SENSITIVITY, IMPEDANCE and COUPLING.
6. Apply the signal to be measured to INPUT A.
7. Adjust the trigger level with LEVEL potentiometer until a stable reading is obtained.
   The GATE lamp lights up all the time even if no triggering takes place.
   The frequency measurement accuracy of PM 6630A and PM 6630B is shown in Fig. VIII-5.

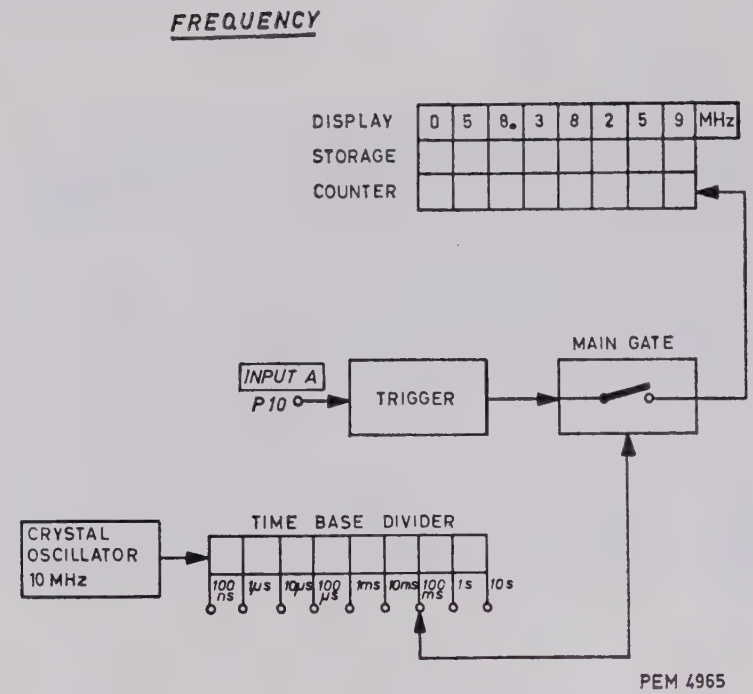


Fig. VIII-7. Simplified block diagram of frequency measurements

FREQUENCY

Time base	DP6	DP5	DP4	DP3	DP2	DP1	DP0	Measurement unit
10 ns								No go
100 ns								No go
1 µs							•	MHz
10 µs						•		MHz
100 µs					•			MHz
1 ms				•				MHz
10 ms			•					MHz
100 ms		•						MHz
1 s				•				kHz
10 s			•					kHz

Decimal-point setting and measurement-unit indication as a function of the TIME BASE switch position.

The frequency of an input signal is measured by counting the number of input pulses which occur within an accurately known time interval. For this purpose the main gate is controlled by pulses derived from the X-tal oscillator which is used as an internal time standard. The 10 MHz oscillator frequency is divided by the time base divider before it is allowed to open the main gate during a time interval of 10 seconds, one second or part of a second.

The trigger circuit shapes the input signal into rectangular pulses which are counted during the time that the main gate is open. The result is displayed together with decimal point and measurement unit.

RATIO

(Frequency ratio $\frac{F1}{F2}$ and multi-ratio $\frac{F1}{F2}$. N

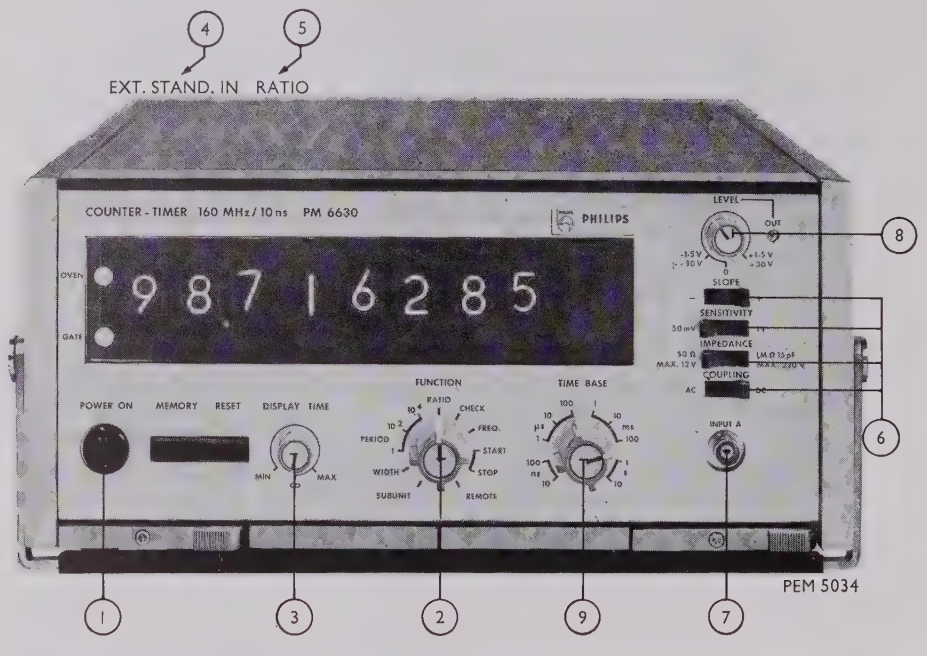


Fig. VIII-8

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to RATIO.
3. Set DISPLAY TIME potentiometer and display-time switch S401 to a suitable value.
4. Apply the signal with the lower frequency (F_2) to input EXT. STAND. IN (rear). Input signal requirements: 1...10 V rms.
   1 KHz...10 MHz.
5. Set switch EXT. STAND. IN (rear) to RATIO
6. Select the proper input conditions in accordance with the input signal applied to INPUT A by means of switches SLOPE, SENSITIVITY, IMPEDANCE and COUPLING.
7. Apply the signal with the higher frequency (F_1) to INPUT A.
8. Adjust the trigger level by means of potentiometer LEVEL until a stable reading is obtained.
9. Select a suitable position for the decimal point by means of switch TIME BASE.
   In the 100 ns position the ratio is displayed without decimal point. In the following positions the ratio displayed is multiplied by 10 up to 10^8.

   In positions 1 s and 10 s there is no decimal point and the "No go" sign is indicated.

TIME BASE setting	Multiplication factor N
100 ns	1
1 μs	10^1
10 μs	10^2
100 μs	10^3
1 ms	10^4
10 ms	10^5
100 ms	10^6
1 s	10^7
10 s	10^8

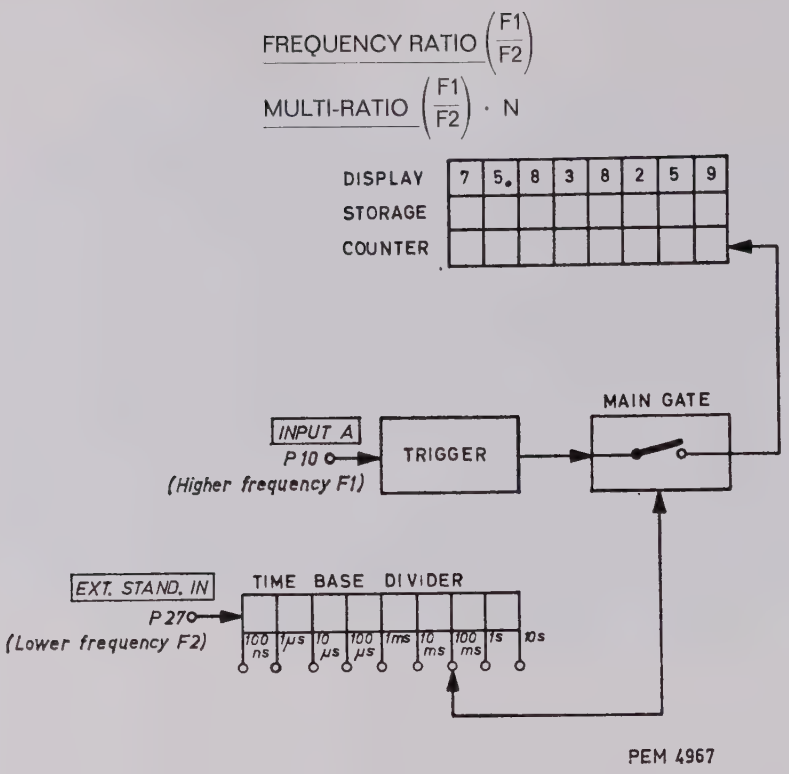


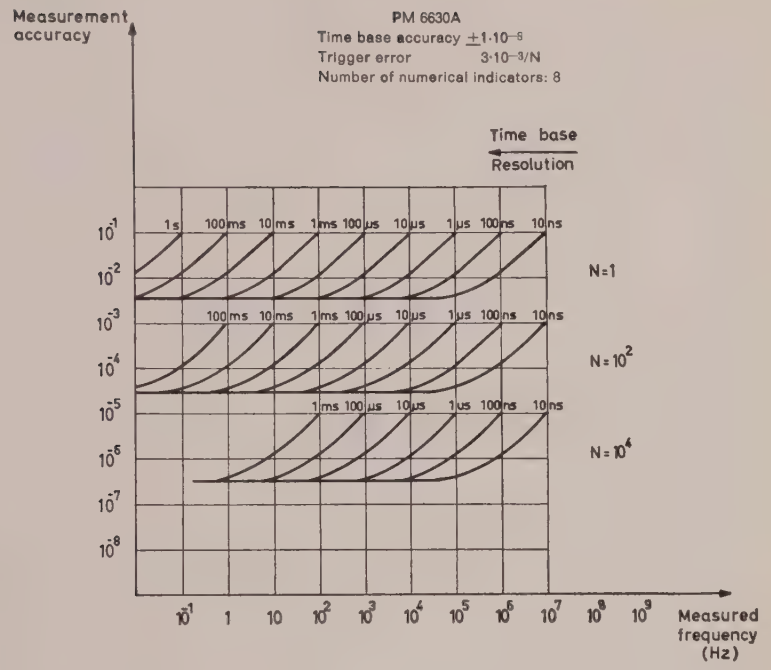
Fig. VIII-9. Simplified block diagram of frequency ratio measurements

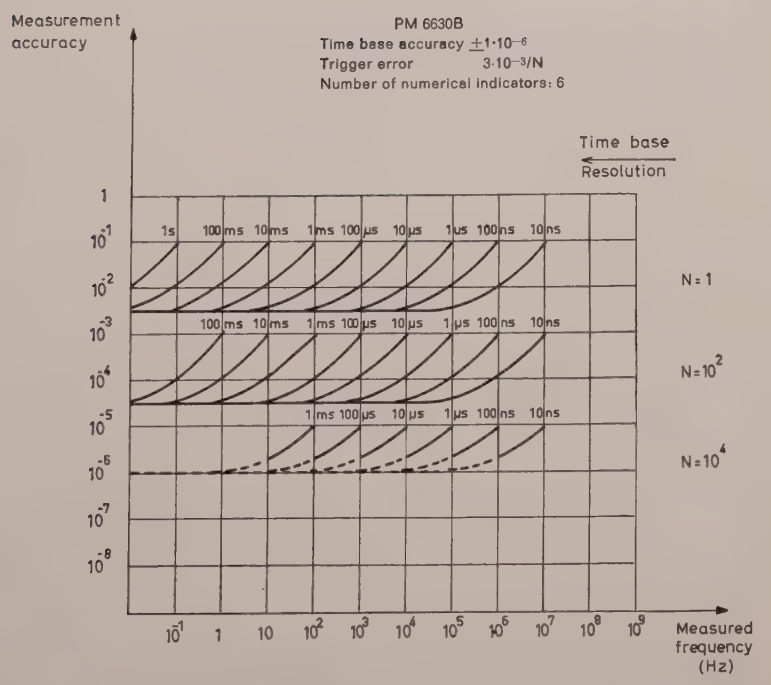
RATIO

Time base	DP6	DP5	DP4	DP3	DP2	DP1	DP0	Measurement unit
10 ns								No go
100 ns							•	
1 µs						•		
10 µs					•			
100 µs				•				
1 ms			•					
10 ms		•						
100 ms	•							
1 s								No go
10 s								No go

Decimal-point setting and measurement-unit indication as a function of the TIME BASE switch position.

Frequency ratio measurements are possible by replacing the time-base standard by an external frequency source. The display is dimensionless, with decimal point. This mode is identical to the frequency mode with the exception that the X-tal oscillator is replaced by an external source (F_2). This source may have any frequency up to 10 MHz. By dividing the lower frequency in the time base divider circuit the ratio can be multiplied by any power of 10, up to 10^8. (10^7 and 10^8 have no decimal point, so that the "No go" sign will be displayed. Apart from the decimal point the function is correct).





Dashed lines indicate that display capacity is exceeded.
N = number of periods averaged.

Fig. VIII-10. Period measurement accuracy for PM 6630A and PM 6630B

SINGLE PERIOD

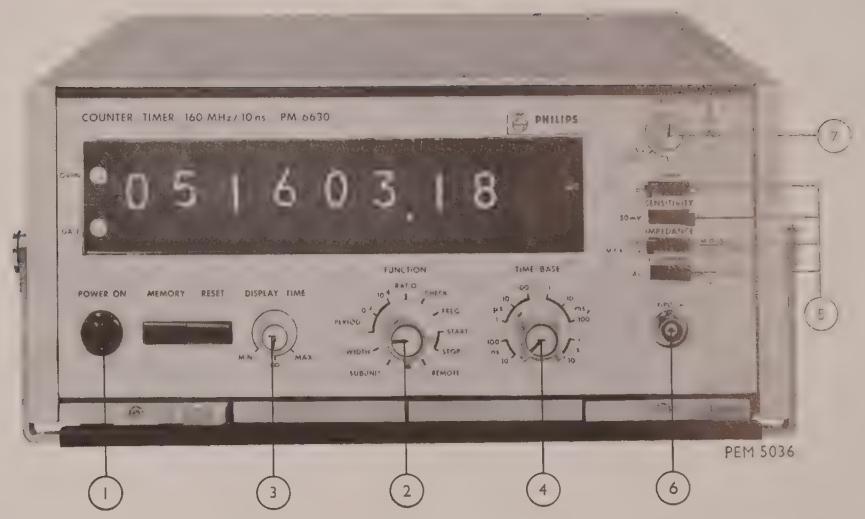


Fig. VIII-11

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to PERIOD 1.
3. Set DISPLAY TIME potentiometer and display-time switch S401 to a suitable value.
4. Set switch TIME BASE to a suitable position to give a sufficient number of digits.
   Time base means **time resolution** in period measurements; i.e. the shortest timing units (10 ns, 100 ns or 1 μs) should be selected.

Example

2.8534 ms = 2853 x 1 μs = 28534 x 100 ns.
With TIME BASE in position 1 μs 4 significant digits and with TIME BASE in position 100 ns 5 significant digits are displayed.

5. Select the proper input conditions in accordance with the input signal by means of switches SLOPE, SENSITIVITY, IMPEDANCE and COUPLING.
6. Apply the signal to be measured to INPUT A.
7. Adjust the trigger level by means of the potentiometer LEVEL until a stable reading is obtained (see note).

   The period measurement accuracy of PM 6630A and PM 6630B is shown in Fig. VIII-10.

Note:

The GATE lamp must blink all the time! Blinking indicates that triggering takes place. (The memory retains the last reading, even if there is no triggering.)

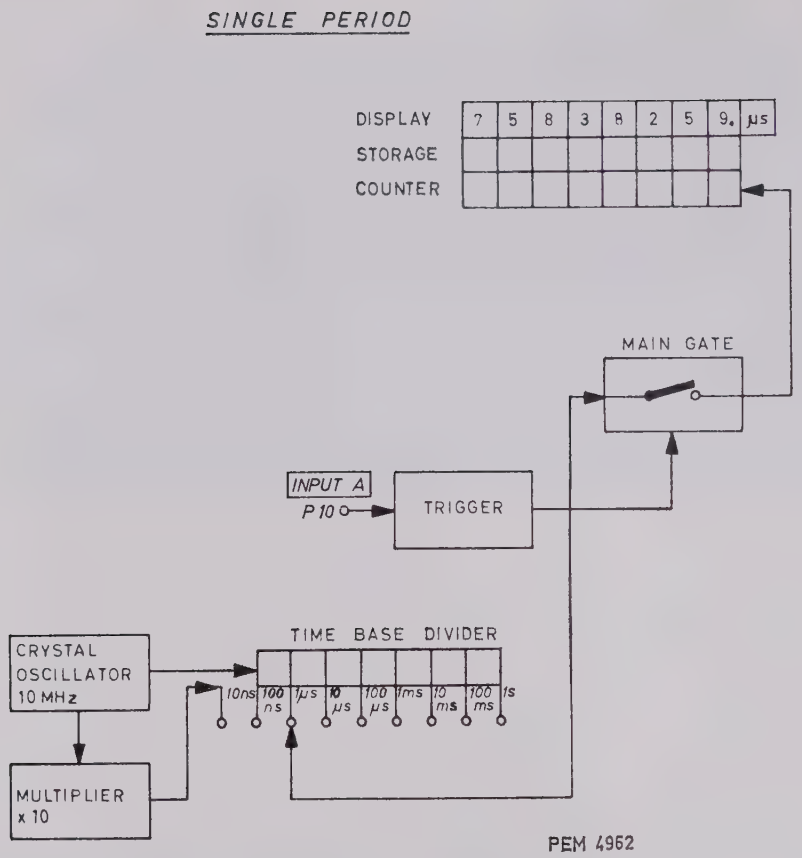


Fig. VIII-12. Simplified block diagram of single period measurements

PERIOD 1

Time base	DP6	DP5	DP4	DP3	DP2	DP1	DP0	Measurement unit
10 ns					•			µs
100 ns						•		µs
1 µs							•	µs
10 µs					•			ms
100 µs						•		ms
1 ms							•	ms
10 ms					•			s
100 ms						•		s
1 s							•	s
10 s								No go

Decimal-point setting and measurement-unit indication as a function of the TIME BASE switch position.

Period time is measured by counting the number of timing units occuring during a time corresponding to **one** period.
The main gate circuit is governed by the input signal. The timing units are derived from the internal X-tal oscillator. As this oscillator is precisely related to time the indication can be expressed in s, ms or µs. The TIME BASE switch determines the time resolution which is 10 ns when 100 MHz is counted, 100 ns when 10 MHz is counted etc.

MULTI PERIOD

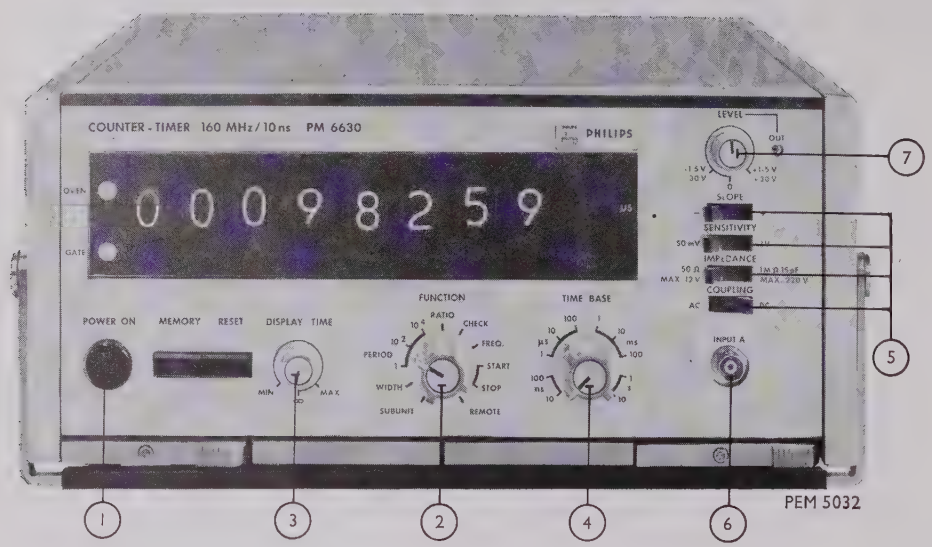


Fig. VIII-13

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to PERIOD 10^2 or PERIOD 10^4.
3. Set DISPLAY TIME potentiometer and display-time switch to a suitable value.
4. Set switch TIME BASE to a suitable position to give a sufficient number of digits.
   Time base means **time resolution** in period measurements; i.e. the shortest timing units (10 ns, 100 ns or 1 μ) should be selected.

   Example

   10^2 x 2.85342 ms = 285342 x 1 μs =
   = 2853424 x 100 ns.
   With FUNCTION in position PERIOD 10^2 and TIME BASE in position 1 μs 6 significant digits and with TIME BASE in position 100 ns 7 significant digits are displayed.
5. Select the proper input conditions in accordance with the input signal by means of switches SLOPE, SENSITIVITY, IMPEDANCE and COUPLING.
6. Apply the signal to be measured to INPUT A.
7. Adjust the trigger level by means of the potentiometer LEVEL until a stable reading is obtained (see note).

The display is equal to the display in single period measurement multiplied by 10^2 or 10^4. This means that the resolution is improved by the same factor. For instance: at a time base setting of 10 ns and with the FUNCTION switch set to position PERIOD 10^4, a resolution of 1 picosecond is obtained.

Some combinations of multi period and time base are not possible. In such cases the "No go" sign is indicated on the display.

The period measurement accuracy of PM 6630A and PM 6630B is shown in Fig. VIII-10.

Note:

The GATE lamp must blink all the time!
Blinking indicates that triggering takes place.
(The memory retains the last reading, even if there is no triggering.)

MULTIPLE PERIOD

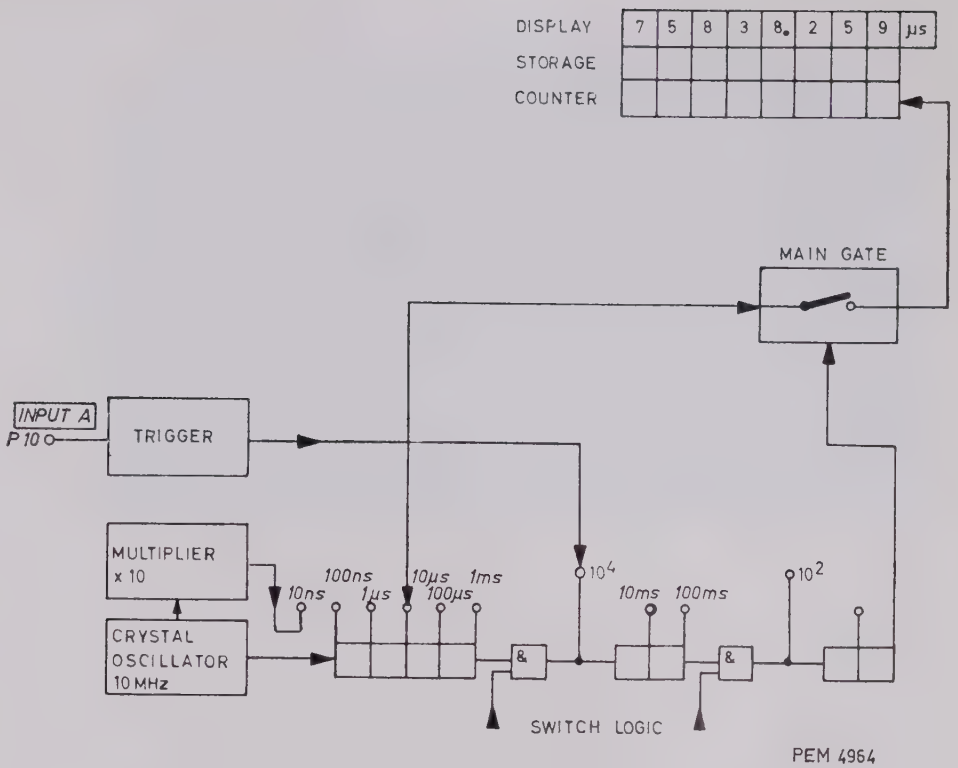


Fig. VIII-14. Simplified block diagram of multi period measurements

PERIOD 10^2

Time base	DP6	DP5	DP4	DP3	DP2	DP1	DP0	Measurement unit
10 ns			•					µs
100 ns				•				µs
1 µs					•			µs
10 µs			•					ms
100 µs				•				ms
1 ms					•			ms
10 ms						•		ms
100 ms							•	ms
1 s								No go
10 s								No go

PERIOD 10^4

Time base	DP6	DP5	DP4	DP3	DP2	DP1	DP0	Measurement unit
10 ns	•							µs
100 ns		•						µs
1 µs			•					µs
10 µs				•				µs
100 µs					•			µs
1 ms						•		µs
10 ms								No go
100 ms								No go
1 s								No go
10 s								No go

Decimal-point setting and measurement-unit indication as a function of the TIME BASE switch position.

The multi period mode is similar to single period mode. The difference is that the incoming signal is divided in some of the time base dividers. 10^2 and 10^4 are chosen as division factors. The remaining part of the divider circuit is used for dividing the X-tal oscillator frequency. As the dividers are used for two purposes it is not possible to use the last two TIME BASE positions at PERIOD 10^2 and the four last positions at PERIOD 10^4. Such combinations are indicated by the "No go" sign. The measurement accuracy is improved in the multi period mode as compared to the single period mode, because the input trigger error is reduced by the division factor.

Frequency or period measurement

It is evident from the diagrams on the accuracy of frequency and period measurements that it is advantageous to use the frequency mode for measuring a high frequency and the period (or multi period) mode for a low frequency. When measuring in the frequency mode greater accuracy will be obtained by using the longest gate time, i.e. 10s.

In the period mode the greatest accuracy is obtained over 10^4 periods and the greatest number of digits by using the shortest timing units namely: 10ns.

A futher study shows that it is possible to obtain greater accuracy with period measurement if the signal has a frequency lower than 200 kHz. The frequency mode on the other hand should be used when the signal is above this frequency. The diagrams showing the period measurement accuracy are valid assuming that the trigger error is 0.3%

PULSE WIDTH OR PULSE SPACING

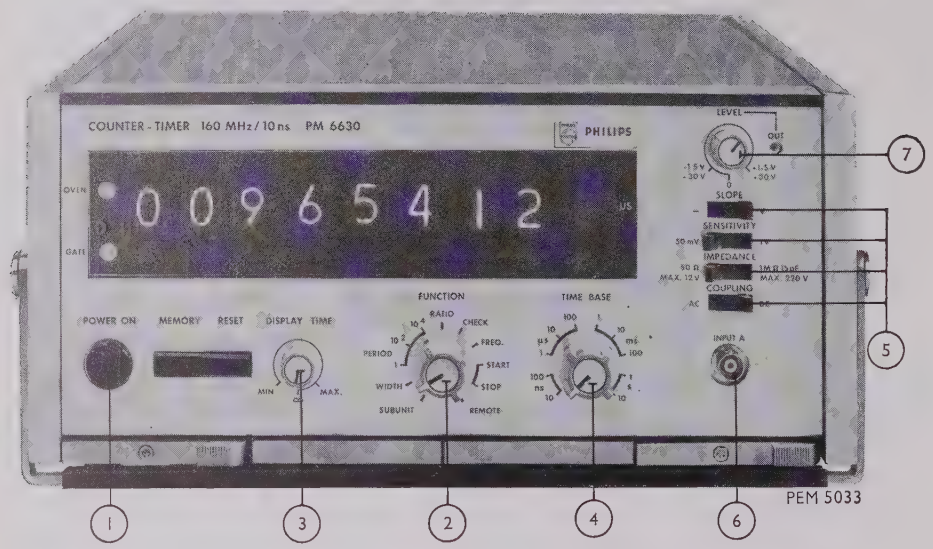


Fig. VIII-15

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to WIDTH.
3. Set potentiometer DISPLAY TIME and display-time switch S401 to a suitable value.
4. Set switch TIME BASE to a suitable position to give a sufficient number of digits.
   Time base means **time resolution** in width measurements; i.e. the shortest timing units (10 ns, 100 ns or 1 μs) should be selected.

   Example

   Measuring a pulse width of 20 μs at a time base setting of 10 ns will give $\frac{200 \cdot 10^{-6}}{10 \cdot 10^{-9}} = 20000$ or 5 digits.
5. Select the proper input conditions in accordance with the input signal by means of switches SLOPE, SENSITIVITY, IMPEDANCE and COUPLING. For the position of the SLOPE switch see note!
   If possible use DC-coupling to avoid differentiation of the pulses.
6. Apply the signal to be measured to INPUT A.
7. Set potentiometer LEVEL to such a position that triggering occurs at 50% of the pulse amplitude (Points A-B in Fig. VIII-16a). Triggering a the levels C-D or E-F will give pulse width values which deviate from the normal definition. Triggering at 50% of the amplitude can be checked in two ways:
   a. Connect SCOPE OUTPUTS, START OUT and STOP OUT by means of a BNC T-connector to channel I of a dual trace oscilloscope.
      The output pulses at these sockets appear practically coincident with the trigger points (only 10 ns delay).
      The waveform to be measured should be applied to channel II.
   b. Apply the trigger signal available at LEVEL output to channel I of the dual trace oscilliscope and the waveform to be measured to channel II.
      The 0-position of both traces should be the same, when the vertical sensitivity of both channels are equal and the SENSITIVITY switch is set to position 50 mV.
      If SENSITIVITY-switch is set to position 1 V the vertical sensitivity of channel II must be decreased 20 times.

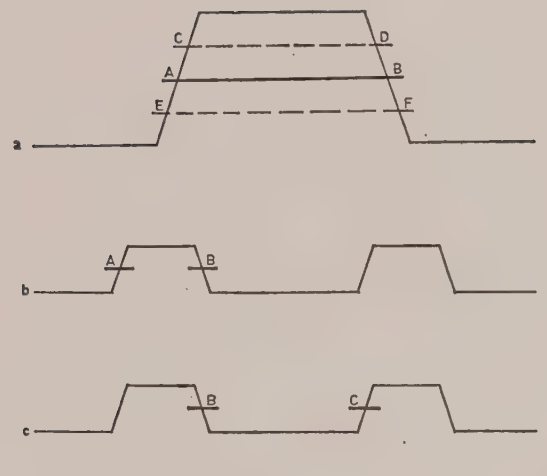


Fig. VIII-16. Trigger level setting at pulse width or pulse spacing measurements

Note:

The measurement is effected in such a way that the internal standard frequency is counted during a gate time which is determined by the time between two successive crossings of the triggering level. See Fig. VIII-16.
From this it follows that the width of a positive pulse is measured if the first trigger pulse is generated by the positive going edge. The gate time is then A-B (Fig. VIII-16b). This condition is valid when the SLOPE switch is set to +. When the SLOPE switch is set to —, the time interval between the negative going edge (B) and the positive going edge (C) is measured, i.e. the spacing between the positive pulses (Fig. VIII-16C).
In the case of pulse width or pulse spacing measurements the time between successive crossings of the trigger level is measured.
The normal definitions of width and spacing refer to the pulse width at 50% of the amplitude. For accurate pulse width or pulse spacing measurements it is therefore necessary that triggering occurs at 50% of the amplitude.
The principle of the width mode is similar to that of the single period mode. One of the trigger circuits opens the main gate while the other closes it. During the time the main gate is open timing units obtained from the TIME BASE are counted. For a positive pulse the SLOPE switch must be set to "+" for pulse width measurement and "—" for pulse space measurement. For negative pulses the inverse applies. This is clarified by means of the pulse diagrams. The display is direct-reading in (s, ms or μs) and has an automatically positioned decimal point.

WIDTH

Time base	DP6	DP5	DP4	DP3	DP2	DP1	DP0	Measurement unit
10 ns					•			μs
100 ns						•		μs
1 μs							•	μs
10 μs					•			ms
100 μs						•		ms
1 ms							•	ms
10 ms					•			s
100 ms						•		s
1 s							•	s
10 s								No go

Decimal-point setting and measurement-unit indication as a function of the TIME BASE switch position.

WIDTH (PULSE WIDTH OR PULSE SPACING)

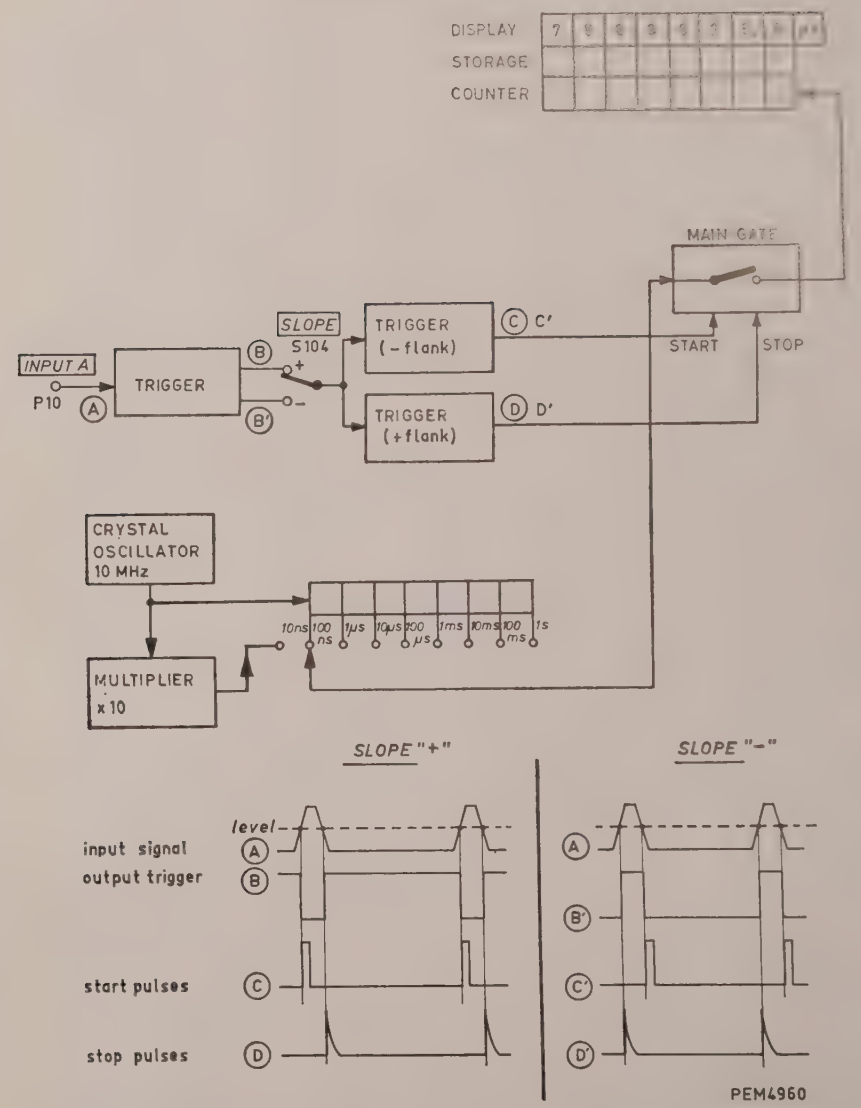


Fig. VIII-17. Simplified block diagram of pulse witdh or pulse spacing measurements

SCALING

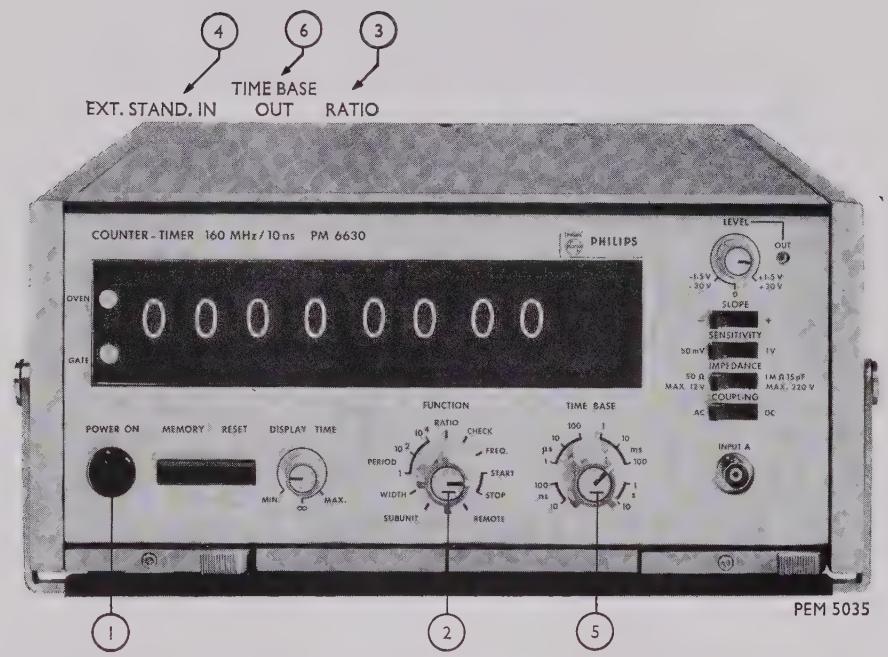


Fig. VIII-18

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to START.
3. Set switch EXT. STAND. IN (rear) to RATIO.
4. Apply the signal to socket EXT. STAND. IN (rear).
5. Select the proper scaling factor by means of switch TIME BASE according the adjacent table
6. The output signal can be taken from socket TIME BASE OUT (rear).

TIME BASE setting	SCALING factor
100 ns	1
1 μs	10
10 μs	10^2
100 μs	10^3
1 ms	10^4
10 ms	10^5
100 ms	10^6
1 s	10^7

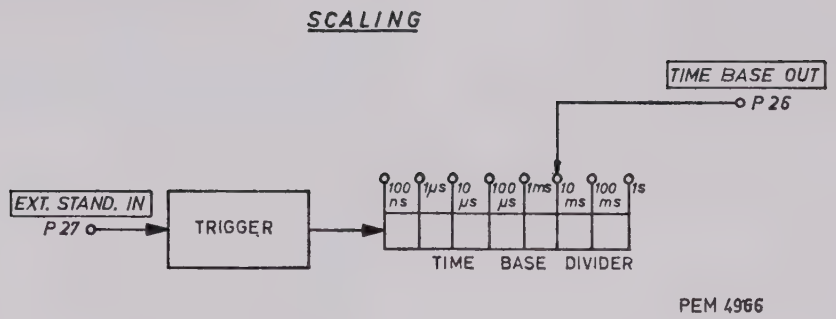


Fig. VIII-19. Simplified block diagram of scaler operation

Scaling means that an incoming signal can be divided by powers of 10 from 1...10^7.
In this mode the input signal is routed through the time base dividers. The scaling factor is selected by means of the TIME BASE switch. The input and output sockets are located at the rear.

C. REMOTE CONTROL (PM 6630A only)

1. Turn on the counter by means of switch POWER ON.
2. Set switch FUNCTION to REMOTE.

Programming

The rear panel connector REMOTE INPUT enables complete control from a remote location, except the controls for the input conditions.
Programming of the desired FUNCTION and TIME BASE is effected by earthing the pins indicated in table I.
Connection to earth can be done directly or by means of a transistor driven into saturation ($Vce_{sat} \leqq 0.5$ V).

Example

Frequency measurement with a time base setting of 100 ms.
The following pins must be earthed:
2, 3, 4, 5, 6, 7, 31, 13, 14, 15, 16, 17, 18, 27 and 29.

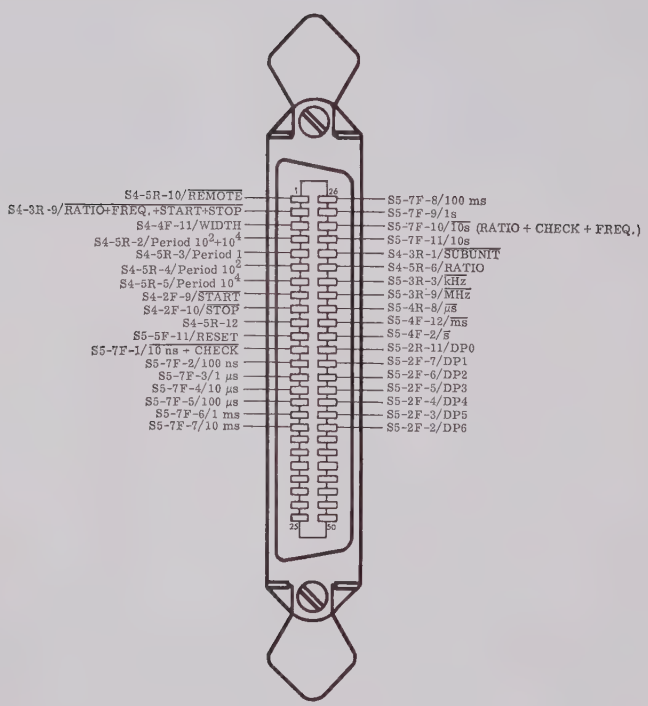


Fig. VIII-20. Connections at REMOTE INPUT plug (P24)

TABLE I

Connector pins	FUNCTION (S4)										TIME BASE (S5)										Open circuit voltage (V)	Short-circuit current (mA)
	SUBUNIT	WIDTH	PERIODx1	PERIODx10²	PERIODx10⁴	RATIO	CHECK	FREQ	START	STOP	10ns	100ns	1 μs	10 μs	100 μs	1ms	10ms	100ms	1s	10s		
P24-1	This pin is earthed when FUNCTION-switch is in position REMOTE																				—	—
2						o		o	o	o											5	1.5
3			o	o	o	o	o	o	o	o											5	1.6
4	o	o	o			o	o	o	o	o											5	1.6
5	o	o		o	o	o	o	o	o	o											5	1.6
6	o	o	o		o	o	o	o	o	o											5	1.6
7	o	o	o	o		o	o	o	o	o											5	3.2
8									o												5	3.2
9										o											5	12
10	o																				5	2.5
11	Earthed when RESET is desired																				5	15
12							o				o										7.5	5
13											o		o	o	o	o	o	o	o	o	5	1.6
14												o		o	o	o	o	o	o	o	5	1.6
15												o	o		o	o	o	o	o	o	5	1.6
16												o	o	o		o	o	o	o	o	5	1.6
17												o	o	o	o		o	o	o	o	5	1.6
18												o	o	o	o	o		o	o	o	5	1.6
19																					—	—
20																					—	—
21																					—	—
22																					—	—
23																					—	—
24																					—	—
25																					—	—
26												o	o	o	o	o	o		o	o	5	1.6
27												o	o	o	o	o	o	o		o	5	1.6
28	o	o	o	o					o	o										o	5	1.6
29											o	o	o	o	o	o	o	o	o		5	1.6
30																					5	1.0
31	o	o	o	o			o	o	o	o											12	2.0
32-50 See table II																						

Programming of the appropriate decimal point and the measurement unit (MHz, kHz, μs ms, s) is effected by earthing the pins indicated in table II.

The pins to be earthed are indicated for each combination of switches FUNCTION and TIME BASE.

TABLE II

	TIME BASE (S5)	10ns	100ns	1μs	10μs	100μs	1 ms	10 ms	100 ms	1s	10s
	FUNCTION (S4)										
SUBUNIT	Time interval PM 6631	34,39	34,38	34,37	35,39	35,38	35,37	36,39	36,38	36,37	—
SUBUNIT	Pre-scaler PM 6632	—	—	—	33,37	33,38	33,39	33,40	33,41	32,39	32,40
SUBUNIT	Pre-amplifier PM 6633	—	—	33,37	33,38	33,39	33,40	33,41	33,42	32,40	32,41
	WIDTH	34,39	34,38	34,37	35,39	35,38	35,37	36,39	36,38	36,37	—
	PERIODx1	34,39	34,38	34,37	35,39	35,38	35,37	36,39	36,38	36,37	—
	PERIODx10^2	34,41	34,40	34,39	35,41	35,40	35,39	35,38	35,37	—	—
	PERIODx10^4	34,43	34,42	34,41	34,40	34,39	34,38	—	—	—	—
	RATIO	—	37	38	39	40	41	42	43		—
	CHECK	—	—	33,37	33,38	33,39	33,40	33,41	33,42	32,40	32,41
	FREQ.	—	—	33,37	33,38	33,39	33,40	33,41	33,42	32,40	32,41
	START										
	STOP										

A stroke (—) in a square means that the combination is impossible.
A blank square means that neither the decimal point nor the measurement unit is indicated.

Max. open circuit voltage: 5 V
Max. short-circuit current: 60 mA pins 32...36
45 mA ,, 37...43

D. BCD-OUTPUT (PM 6630A only)

The counter display information can be supplied to a digitial recorder or digtal-to-analog converter. This information is available on socket BCD OUT (P25) at the rear.

Table III shows on which pins the signals are available and to which pins the external signal required should be applied.

TABLE III

SURVEY OF CONNECTIONS AT SOCKET BCD OUT (P 25)

P25 Pin no.		P25 Pin no.			
1	A	26	C	1st	decade
2	B	27	D	(units)	
3	A	28	C	2nd	decade
4	B	29	D	(tens)	
5	A	30	C	3rd	decade
6	B	31	D	(hundreds)	
7	A	32	C	4th	decade
8	B	33	D	(thousands)	
9	A	34	C	5th	decade
10	B	35	D	(ten thousands)	
11	A	36	C	6th	decade
12	B	37	D	(hundred thousands)	
13	A	38	C	7th	decade
14	B	39	D	(millions)	
15	A	40	C	8th	decade
16	B	41	D	(ten millions)	
17		42			
18		43			
19		44			
20		45			
21		46			
22	Inhibit	47			
23	Print command	48			
24	Reference logic"0"	49			
25	Reference logic"1"	50	± 0 V		

OUTPUT

4-line BCD	Logic "0":	≦ 1 V	for I_{out} ≧ -4 mA
1-2-4-8	Logic "1":	> 7.5 V	for I_{out} ≧ 0.4 mA
Print command	supplied at the end of each measurement		
	pulse amplitude	> 5.8 V	for I_{out} < 4 mA
	rise time	< 5 μs	
	width	> 20 μs	
Reference logic "1"	V_{out}	≧ 10 V	
	Source impedance	< 1 kΩ	
Reference logic "0"	V_{out}	≦ 2 V	
	Source impedance	< 1 kΩ	

INPUT

Inhibit: Counter recycling inhibited if voltage level exceeds 5.5 V
Input current < 4 mA

Truth table for each decade

D=8	C=4	B=2	A=1	Digit
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

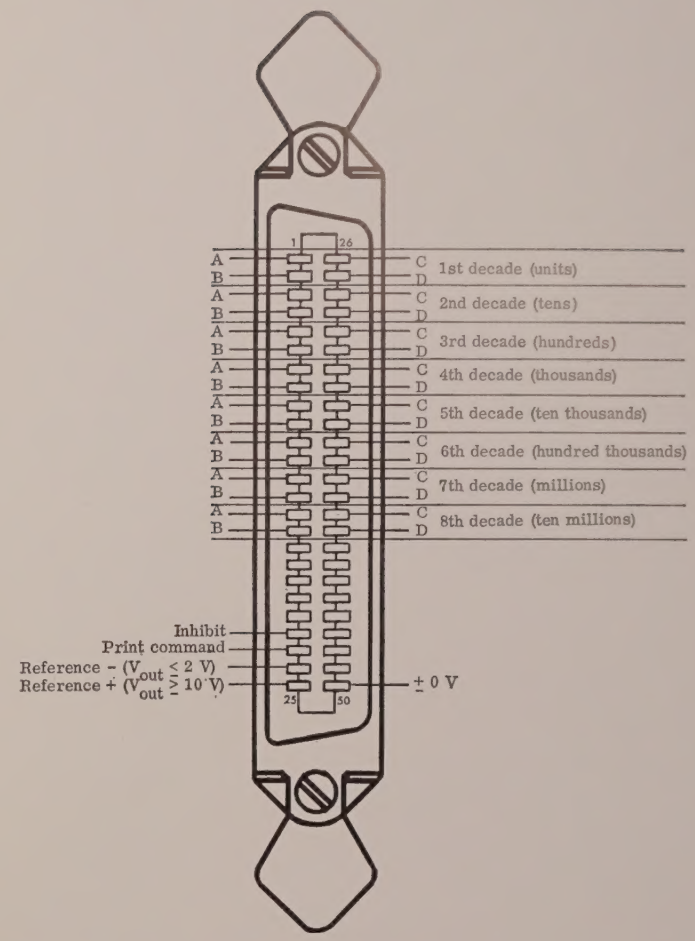


Fig.VIII-21. Connections at plug BCD OUT

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